

## *Eucheuma denticulatum*



The typical thallus and spikey branches of a *Eucheuma denticulatum* specimen. *Eucheuma* attaches to substrate and coral via many attachment points making complete removal without fragmentation difficult. *Eucheuma* populates most of the patch reef systems in Kaneohe Bay and many of the outer portions of fringe reef systems.

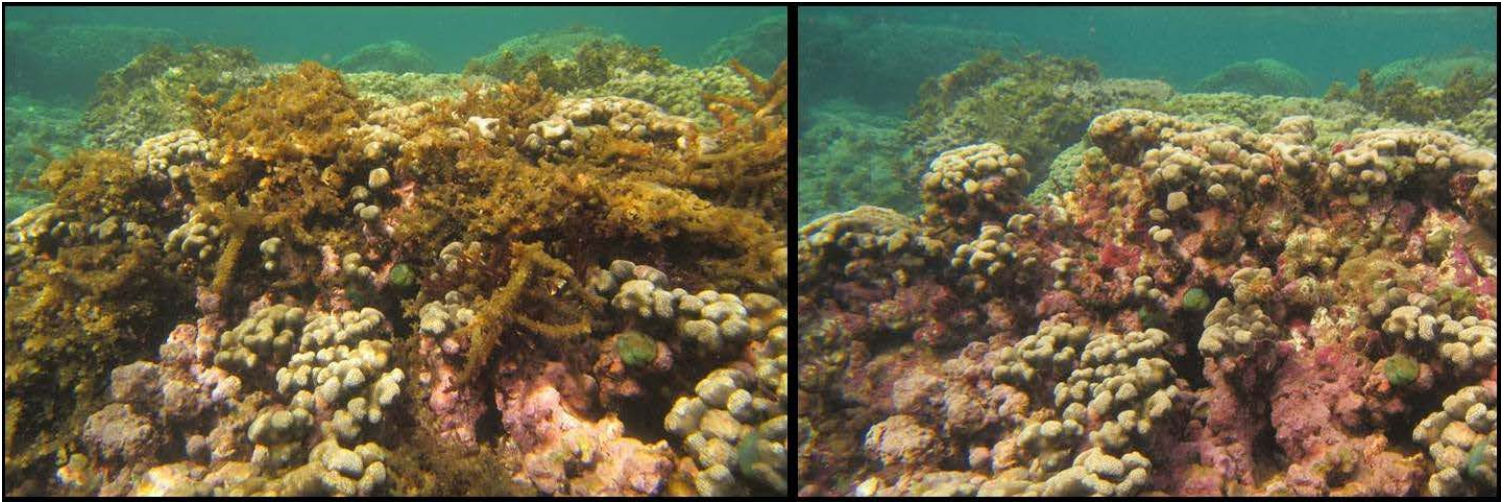


Damage caused to coral colonies by *Eucheuma denticulatum*. The pink pigmentation is theorized to be an inflammatory-like response to irritation caused by algae abrasion and over growth. In this case the coral colony is being broken apart from within as the algae grows from the base out towards the top.

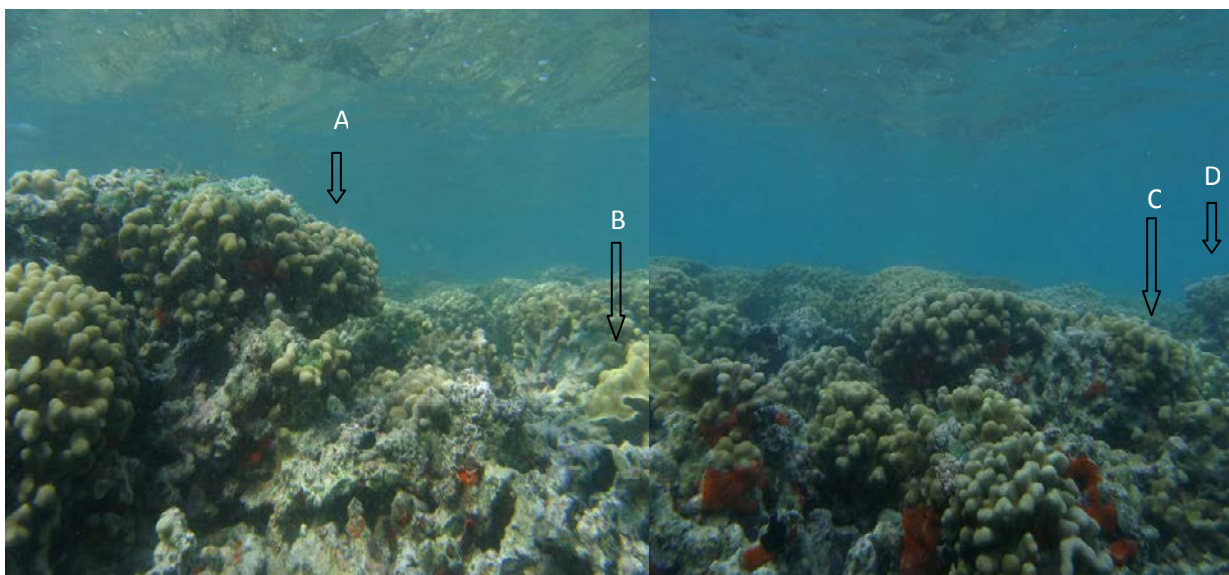
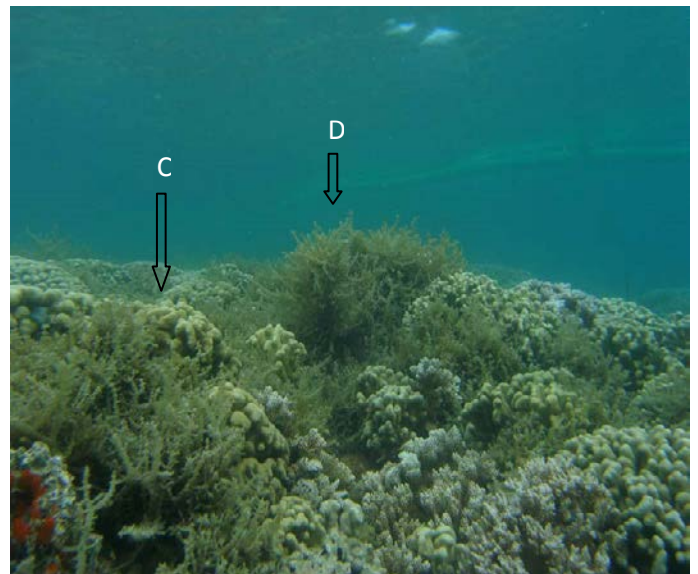
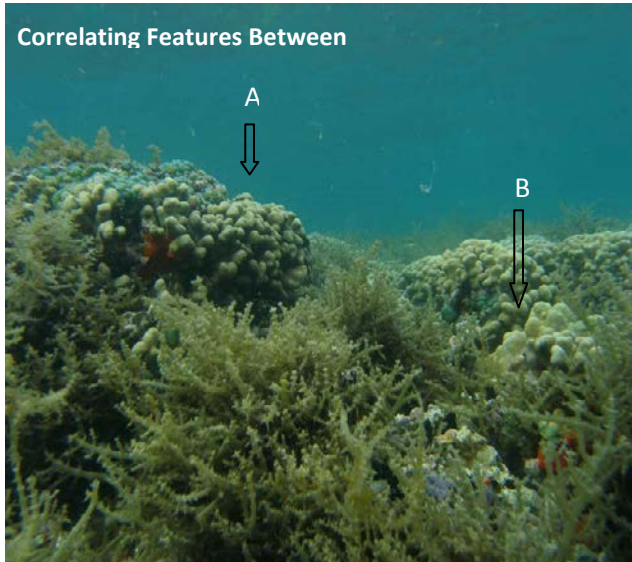


*Eucheuma denticulatum* creates thick algal mats that carpet the coral and restrict the radiance received by coral polyps, ultimately stopping photosynthesis within the polyp. Once photosynthesis stops the colony dies beneath the carpet of *Eucheuma denticulatum*.



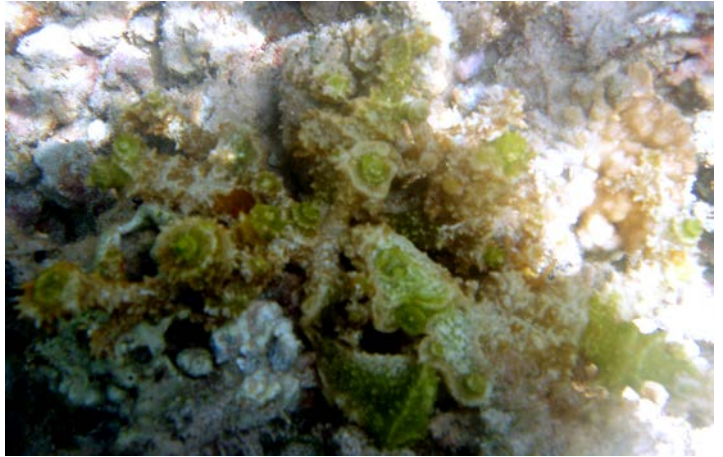


These before and after photos demonstrate the coral mortality caused by the thick carpeting of *Eucheuma denticulatum*. Once the thick algal mats are removed, dead coral structure (or pavement) covered by crustose coralline algae (purple in the picture above, pale pink/grey in picture below) is what remains underneath. The coral that occupied these spaces will never rebound, complete mortality of this portion of the colony has occurred. It is theorized that keeping the spaces free of a recurring algal invasion may induce the settlement of new coral polyps from the parent colony (or larval recruits in the water column) and trigger new growth and rehabilitation.





## *Kappaphycus Clade B*



The typical thallus and branches of a *Kappaphycus Clade B* specimen. *Kappaphycus Clade B* also attaches to substrate and coral via many attachment points making complete removal without fragmentation difficult. *Kappaphycus Clade B* is less prevalent than *Eucheuma denticulatum* but also populates most of the patch reef systems in Kaneohe Bay and many of the outer portions of fringe reef systems. *Kappaphycus Clade B* is the only species out of the three species of the *Kappaphycus spp. Complex* that has been observed to be spreading in early successional stages up the East coast of Oahu as far as Punulu'u. It has also been detected in early successional stages near Haleiwa boat harbor in Ali'i beach. The morphology of *Kappaphycus Clade B* typically displays more nub-like growth often with concentric spirals as opposed to the spikes of *Eucheuma*. The color can often be vibrant green, but has been observed with the same olive green coloration as *Eucheuma* (see bottom right).



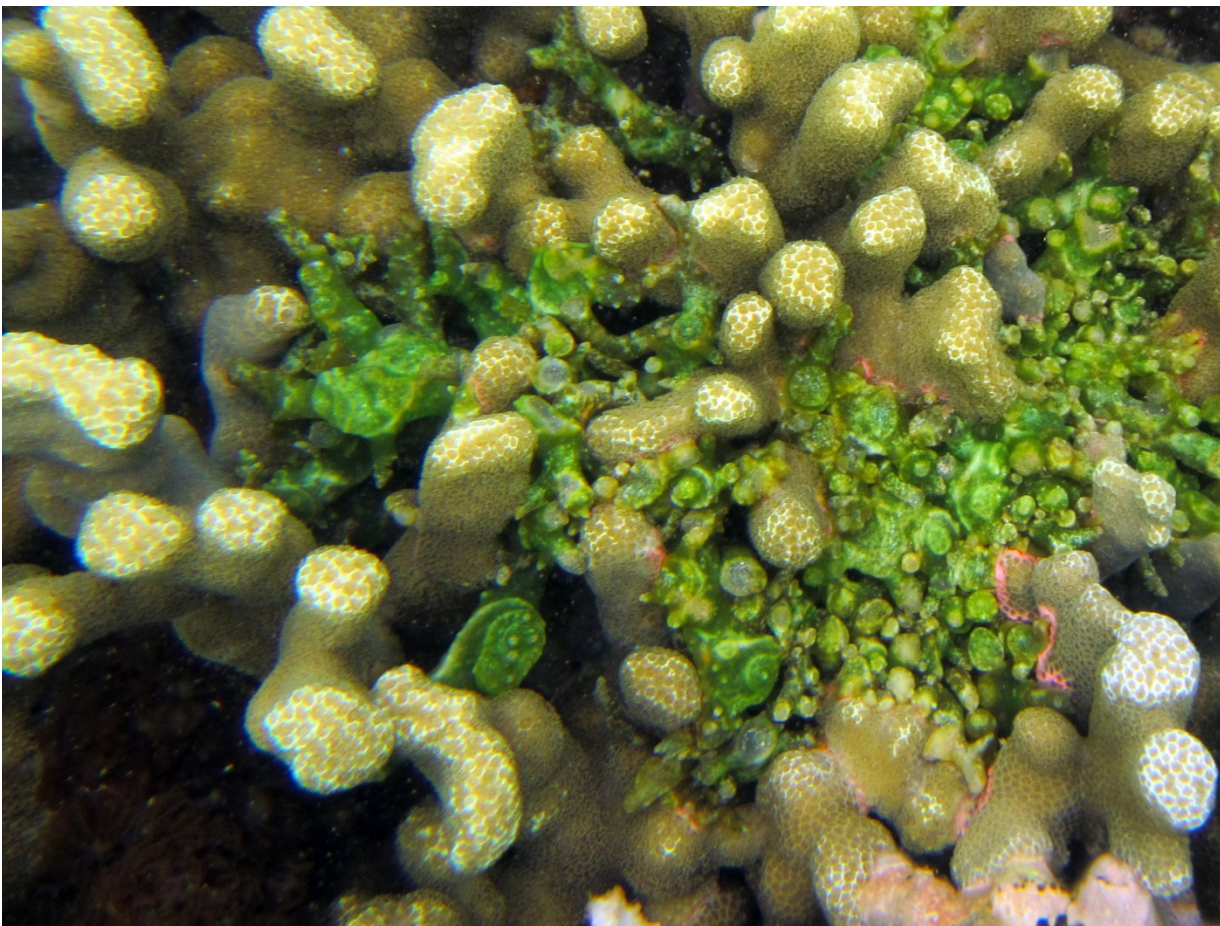




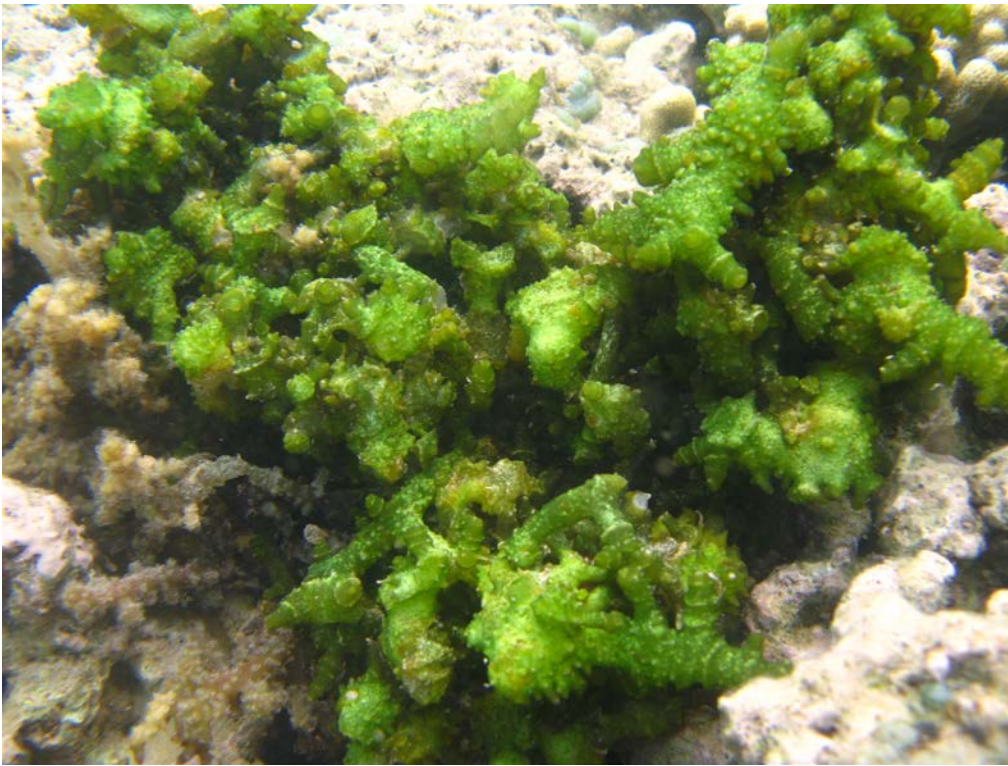
Damage caused to coral colonies by Kappaphycus Clade B.

(Left) The attachment point between the thalli (branch) of Kappaphycus Clade B and surface of the coral *Porites compressa*, displaying that the polyps have been over grown and only the calcareous skeleton of the coral remains.

(Below) Similar to the growing nature of *Eucheuma denticulatum*, the abrasive and crowding nature of Kappaphycus Clade B irritates the coral. The pink pigmentation is theorized to be an inflammatory-like response to irritation caused by algae abrasion and over growth. This *Porites compressa* coral colony is being broken apart from within as the algae grows from the base out towards the top.







*Kappaphycus Clade B* creates thick algal mats (similar to *Eucheuma denticulatum*) that carpet the coral and restrict the radiance received by coral polyps, ultimately stopping photosynthesis within the polyp. Once photosynthesis stops the colony dies beneath the carpet of *Kappaphycus Clade B*. Often times *Kappaphycus Clade B* will grow into large mounds over a coral colony, making removal easier, but it also displays the same growing tendency to infest the coral at the base, causing the coral colony to be broken apart from within as the algae grows out towards the top.



## *Kappaphycus Clade A*

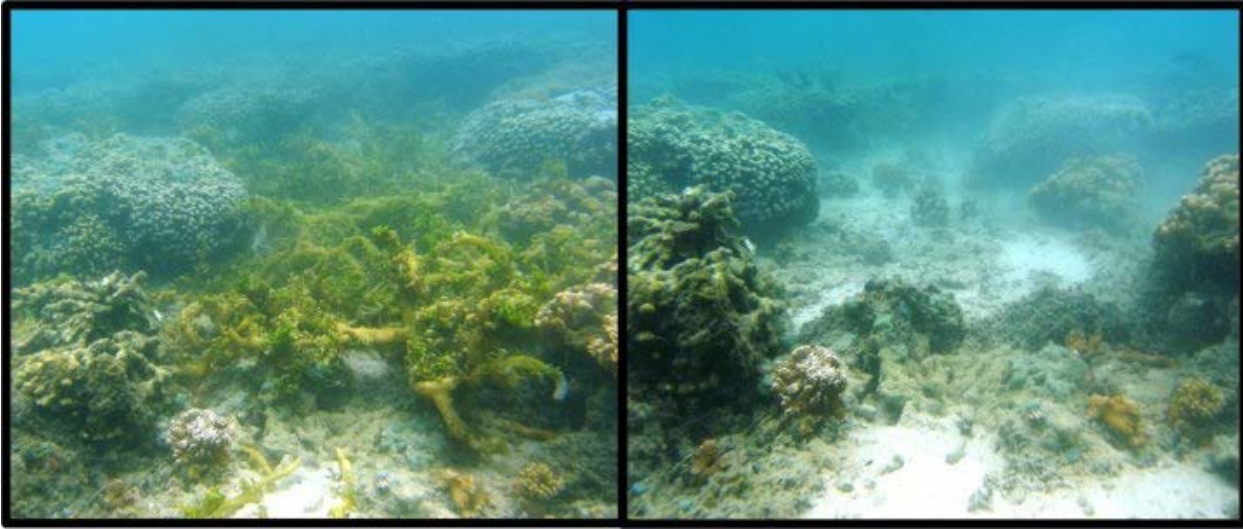


In Kaneohe Bay, *Kappaphycus Clade A* has basically two morphologies within its structure. The main thallus is either thick with many thick diverging branches and coarse nubs along its surface (above) or it can be thick with several thinner diverging branches and completely smooth along its surface (below). *Kappaphycus Clade A* seems to be prevalent in only a few locations in Kaneohe Bay, namely outside Heeia fish pond, on the fringing reefs direct adjacent to Heeia fish pond (north and south), on the fringing reefs opposite Coconut Island and on Coconut Island itself.









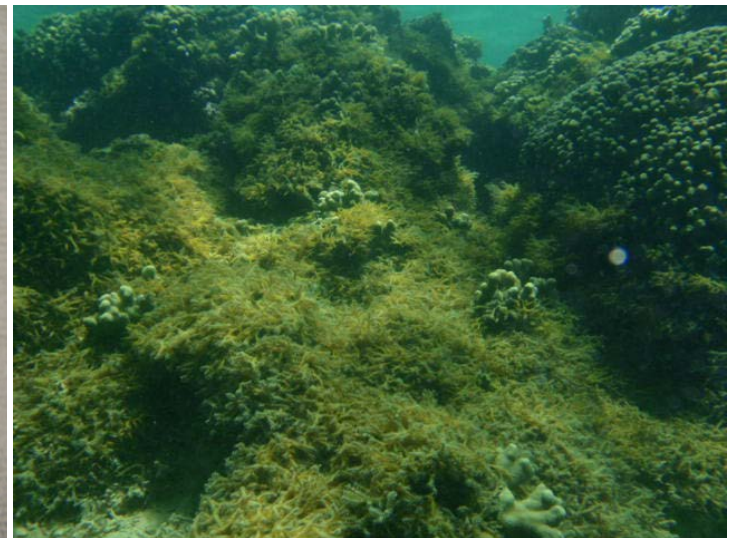
*Kappaphycus Clade A* is the least detrimental to coral colonies out of the three species of the *Kappaphycus* spp. Complex, as it tends to have far fewer attachment points to actual coral colonies. Therefore coral colonies are not destroyed from the inside out via multiple attachment points. However, *Kappaphycus Clade A* is so gargantuan in size that its growth tends to fill large spaces between colonies restricting colonization of native algae, sea grasses or new coral colonies within these open spaces (photos on previous page and before/after photos above). In addition, *Kappaphycus Clade A* can certainly produce large bundles over colonies, restricting the radiance received by coral polyps, ultimately stopping photosynthesis within the polyp. Once photosynthesis stops the colony dies beneath the bundle of *Kappaphycus Clade A*, ensuring mortality through the shading.



## *Gracilaria salicornia*



The typical smooth branches with segmented nodules of a *Gracilaria salicornia* specimen (Above left/right). *Gracilaria salicornia* is usually orange/brown in coloration but can also be olive green/yellow depending on the intensity of light sources available to the algae. *Gracilaria* attaches to substrate and coral via many attachment points making complete removal without fragmentation difficult. *Gracilaria* populates most of the inland portions of fringe reef systems in Kaneohe Bay and many of the patch reefs, growing mainly towards the center of the reef.



*Gracilaria salicornia* creates thick algal mats that carpet the coral (above right) and restrict the radiance received by coral polyps, ultimately stopping photosynthesis within the polyp. Once photosynthesis stops the colony dies beneath the carpet of *Gracilaria salicornia*.